**Predicting and acting on risks**

**Objective:** Students will be able to use qualitative risk analysis as a basis for deciding which policies should be developed for addressing global climate change.

We all face risks and we have a variety of ways of evaluating what we should do about those risks. In a general, we evaluate risks by estimating two parameters. First, we estimate the probability of the risky event happening and secondly, we evaluate the severity of the risk. If someone is involved in a behavior that has a high probability of causing that person harm, we either say the person is foolish or perhaps brave depending on the circumstance. In many cases we do not know the precise probability of a future event nor do we know exactly how severe a future event will be. However, we can often predict whether the probability of an event occurring is high, medium or low and we can predict if the severity is likely to be high, medium or low. In addition, we can improve our evaluation of risk by stating whether our confidence in rating risk or severity is high, medium, or low. You might state that you think the probability of a certain event is high but you might be quite uncertain that your evolution is correct. In other words, you might also think the probability of the event could be medium or even low.

Using this approach of ranking risks, we can estimate the risk of any particular event as some measure of the potential severity of a particular event multiplied by the certainty of that severity multiplied by the probability of the event multiplied by the degree of certainty that the probability is correct.

Risk= (severity of event) x (certainty of severity) x (probability of event occurring) x (certainty of probability).

In some cases, the equation above can be completed with agreed upon numbers. In these cases, we call the resulting analysis *quantitative risk analysis*. However, we often have to make our best guess. We call the resulting analysis *qualitative risk analysis*.

***You have to quit smoking***

I’ve been trying to convince my friend to quit smoking but it is a tough habit to break. According the Center for Disease Control, tobacco use is the single most common cause of preventable death in the U.S. Each year, approximately 440,000 people in the U.S. die of tobacco related illness. Almost 30% of these are deaths due to lung cancer and slightly over half are various types of heart disease. I figure these numbers should scare anyone into action.

But my friend argues that I’m just buying into the scare tactics of people who have it out for the tobacco industry. She says, “I’ve enough stress in my life without adding quitting smoking to the list. A cigarette calms me down. Besides, the evidence isn’t as strong as you think. Only about one-third of the people who die of heart disease are smoker.” She also points out that lung cancer accounts for less than one quarter of the annual cancer deaths. “Something is going to get me eventually”, she says. She also argues that other things than smoking cause lung cancer, such as radon gas and air pollution. “I live in New York City. Cigarette smoke may be less harmful than the city air”, she says.

Sometimes my friend weakens a bit and says, “Yeah, I’m going to quit someday. Now just isn’t the right time. I will quit in a few years when my life is more stable”. But smoking causes cumulative damage. The cigarettes she is smoking today isn’t likely to kill her soon but the longer she waits to stop, the more likely she is to develop lung cancer or heart disease. Lung cancer strikes only about 1 in 3000 women under the age of 40. By the time she reaches 60 or 70, the cancer rates go up to about 1 in 26. If she quits smoking, her chance of getting lung caner will diminish, but she’ll always be at a higher risk than someone who never smoked.

Maybe scientists will find a cure for lung cancer and my friend will be fine. I hope so.

***We need to stop our carbon emissions.***

There have been lots of national and international conferences aimed at convincing countries to reduce their carbon emissions to slow global warming but no progress has been made. There is a broad consensus among scientists that global warming is occurring due to carbon emissions but the predictions for future climate changes are quite variable (Figure 1).

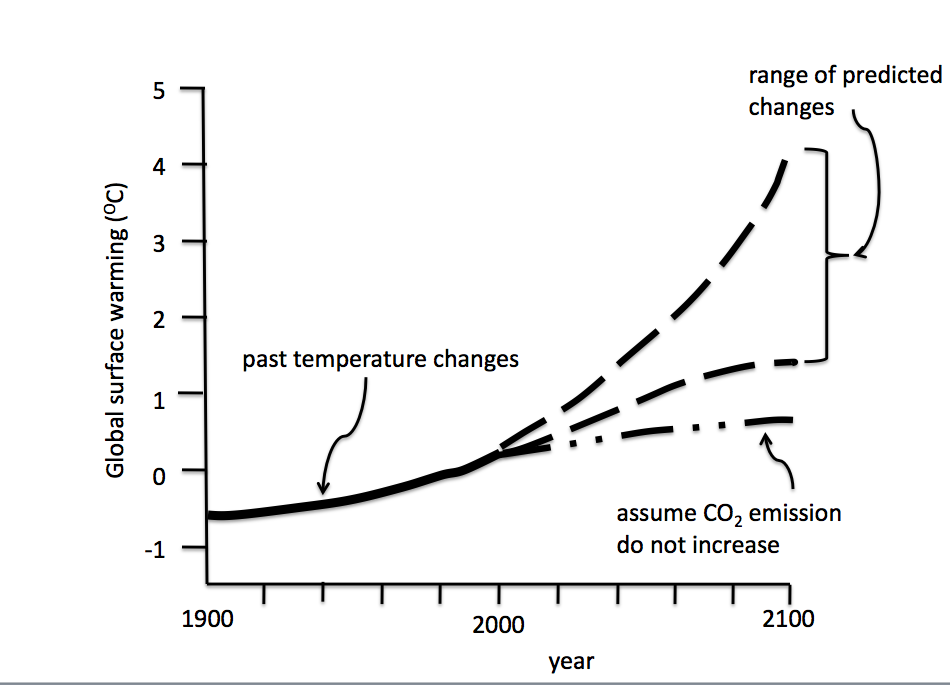


Figure 1.

It is well established that carbon dioxide in the atmosphere has a “greenhouse effect” and that past global temperature changes closely track the amount of carbon dioxide in the atmosphere. Still, many non-scientists are not convinced that the situation warrants action. The following is from a Dec. 9, 2009 Washington post editorial by form Republican vice- presidential candidate Sarah Palin.

Our representatives in Copenhagen should remember that good environmental policymaking is about weighing real-world costs and benefits -- not pursuing a political agenda. That's not to say I deny the reality of some changes in climate -- far from it. I saw the impact of changing weather patterns firsthand while serving as governor of our only Arctic state. I was one of the first governors to [create a subcabinet](http://gov.state.ak.us/admin-orders/238.html) to deal specifically with the issue and to recommend common-sense policies to respond to the coastal erosion, thawing permafrost and retreating sea ice that affect Alaska's communities and infrastructure.

But while we recognize the occurrence of these natural, cyclical environmental trends, we can't say with assurance that man's activities cause weather changes. We can say, however, that any potential benefits of proposed emissions reduction policies are far outweighed by their economic costs.

Palin confuses climate and weather and this may help explain why she thinks humans may not be causing climate change. She is also correct that humans are not the only cause of climate change. There are natural cycles. In fact, the present natural cycle is one of cooling.

Any attempt to significantly reduce human impact on climate will, at least initially, cost money. Some people argue that uncertainties in the hazards posed by climate change are so large that we are better off simply banking the money to use in the future if we find we need to. Here is the gist of the arguments in simple numbers.

1) The do nothing now group. Since we don’t know how much damage, if any, climate change we cause, then the best thing to do is to “bank” the money. The government should create a climate change trust fund and put 1 billion dollars per year into the fund. The fund money could be invested in government bonds that pay 5% interest annually. In 50 years, the investment will be almost 200 billion dollars, which could be spent, as need, to address any problems. If it is not needed, then the government could use the money for other needs.

2) The do something now group. We can predict that the consequences of global warming will be huge and waiting to slow emissions will only make things worse. Furthermore, they argue, it is hard to put a dollar value on the human toll of climate change. The following is synopsis of the toll climate change may take is from the World Health Organization (http://www.who.int/globalchange/en/)

From the tropics to the arctic, both climate and weather have powerful impacts, both direct and indirect, on human life. While people adapt to the conditions in which they live, and human physiology can handle substantial variation in weather, there are limits.

Marked short-term fluctuations in weather can cause acute adverse health effects:

* Extremes of both heat and cold can cause potentially fatal illnesses, e.g. heat stress or hypothermia, as well as increasing death rates from heart and respiratory diseases.
* In cities, stagnant weather conditions can trap both warm air and air pollutants -- leading to smog episodes with significant health impacts.
* These effects can be significant. Abnormally high temperatures in Europe in the summer of 2003 were associated with at least 27,000 more deaths than the equivalent period in previous years1 .

Other weather extremes, such as heavy rains, floods, and hurricanes, also have severe impacts on health. Approximately 600,000 deaths occurred world-wide as a result of weather-related natural disasters in the 1990s; and some 95% of these were in poor countries. Some examples:

* In October 1999, a cyclone in Orissa, India, caused 10,000 deaths. The total number of people affected was estimated at 10-15 million;
* In December 1999, floods in and around Caracas, Venezuela, killed approximately 30,000 people, many in shanty towns on exposed slopes.

In addition to changing weather patterns, climatic conditions affect diseases transmitted through water, and via vectors such as mosquitoes. Climate-sensitive diseases are among the largest global killers. Diarrhoea, malaria and protein-energy malnutrition alone caused more than 3.3 million deaths globally in 2002, with 29 % of these deaths occurring in the Region of Africa.

***Part A. Alignment and Decision making.***

In many ways, the decision to quite smoking and the decision to reduce carbon emissions are analogous. That is, there are aspects of deciding to quit smoking that correspond to aspects of deciding to do something about global climate change. Before aligning the smoking scenario with the global scenario, complete tables 1a and b and table 2 by listing elements severity, certainty of the severity, probability of the event occurring and certainty of the probability for smoking (Table 1) and the global climate change (Table 2). One row of table 1 has been completed to serve as an example.

Table 1a Risk analysis table for smoker assuming the smoker does not quit

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **event** | **severity** | **certainty** | **probability the smoker will be impacted by the event** | **certainty** |
| Cancer from smoking | high | high | medium | high |
| Heart disease from smoking | *high* | *high* | *medium* | *high* |
| Increased stress from quitting smoking | *low* | *medium* | *medium* | *medium* |

Table 1b Risk analysis table for smoker assuming the smoker quits by age 30

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Event** | **severity** | **certainty** | **probability the smoker will be impacted by the event** | **certainty** |
| Cancer from smoking | *high* | *high* | *low* | *high* |
| Heart disease from smoking | *high* | *high* | *low* | *high* |
| Increased stress from quitting smoking | *low* | *medium* | *medium* | *medium* |

Table 2 Risk analysis table for people assuming carbon emissions are not severely reduced

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Event** | **severity** | **certainty** | **Probability that some people will be impacted by the event** | **certainty** |
| Increased death rates from extreme heat and cold | *high* | *high* | *high* | *high* |
| Health problems due to increased smog | *medium* | *high* | *high* | *high* |
| Increased death rates due to extreme weather | *high* | *high* | *high* | *high* |
| Increase death due to disease | *high* | *high* | *high* | *high* |
| Wasted expenditures if climate change is minimal | *medium* | *medium* | *low* | *high* |

Having completed the risk analysis tables, we can now see if various decisions about quitting smoking and reducing carbon emissions are analogous with respect to risk. In table 3 compare events associated with smoking for a person who doesn’t quit with the risks of not reducing carbon emissions.

Table 3- doesn’t quit smoking

|  |  |
| --- | --- |
| **Event associated with carbon emissions** | **Event associated with smoking** |
| Increased death rates from extreme heat and cold | *Increase death rate due to cancer or heart disease* |
| Health problems due to increased smog | *Increase death rate due to cancer or heart disease* |
| Increased death rates due to extreme weather | *Increase death rate due to cancer or heart disease* |
| Increase death due to disease | *Increase death rate due to cancer or heart disease* |
| Wasted expenditures if climate change is minimal | *Increased stress from quitting smoking* |

**Part B. Alignable differences;**

Making analogies isn’t just about finding what’s similar between two domains, but also discovering and understanding important differences.

One of the differences between the decision my friend makes about smoking and decisions governments and individuals make about addressing climate change is that my friend is making a decision about her own future health whereas when we make decisions about climate change, we are making decisions that will impact the well-being of others. Complete table 4 by listing some additional differences between the risks of not quitting smoking ands risk of not reducing carbon emissions.

Table 4

|  |  |
| --- | --- |
| **Smoking** | **Climate change** |
| Danger is to the smoker | Danger is not necessarily to the carbon emitter |
| *No cost in quitting* | *Reducing emissions may be very costly* |
| *Only the smoker needs to decide to quit* | *Many interest groups have to cooperate* |

**Part C. Decision making**

1. Based on your qualitative risk analysis, should my friend quit smoking? Explain your reasoning.

Yes- the risks of not doing so are high and the costs are low.

2. Based on your qualitative risk analysis, should we reduce carbon emissions? Explain your reasoning.

**Assessment:**

There have been several international conferences with goal of addressing climate change but none of these have resulted in legislation that would reduce U.S carbon emissions. At the same time, there has been legislation to reduce air and water pollution.

1) Do the risks posed by climate change warrant government expenditures of $280billion per year? Note: it is hard to estimate the cost of greenhouse gas reduction but most economist argue it would cost the US roughly $200 million per year to keep carbon emissions at 1997 levels. Total government expenditures in $2010 were approximately $6,000 billion.